

What is claimed is:

1. A method to prepare a cross-linked sol-gel like material comprising contacting a sol-gel like material with a cross-linking agent to provide the cross-linked aerogel.
2. The method of claim 1, wherein the cross-linking agent is an isocyanate.
3. The method of claim 1, wherein the cross-linking agent comprises a diisocyanate, an acid anhydride, an acylchloride, a bis(acid anhydride), or a bis(acylchloride).
4. The method of claim 1, wherein the cross-linking agent comprises an attached group.
5. The method of claim 4, wherein the attached group is an absorbant, a catalyst, a fluorophore, a biomolecule, a redox active label, or a reactive group.
6. The method of claim 1, further comprising drying the cross-linked sol-gel like material to form a cross-linked aerogel.
7. The method of claim 6, wherein the cross-linked aerogel is a silica aerogel.
8. The method of claim 1, wherein the sol-gel like material is substantially filled with a solvent.
9. The method of claim 8, wherein the solvent is selected from the group consisting of water, ketones, alcohols, esters, carbonates, lactones, and mixtures thereof.
10. The method of claim 9, wherein the alcohol is methanol or ethanol.
11. The method of claim 9, wherein the ketone is acetone.

12. The method of claim 9, wherein the solvent is propylene carbonate, ethyl acetate, or butyrolactone.
13. The method of claim 1, wherein the sol-gel like material is based on silica.
14. The method of claim 13, wherein the silica is prepared from alkoxy silica via an acid or a base-catalyzed route.
15. The method of claim 1, wherein the cross-linking agent is in a solvent.
16. The method of claim 15, wherein the solvent is selected from the group consisting of water, alcohols, ketones, esters, carbonates, lactones, and mixtures thereof.
17. The method of claim 16, wherein the alcohol is methanol or ethanol.
18. The method of claim 2, wherein the isocyanate is a monoisocyanate, a diisocyanate, a triisocyanate, a tetraisocyanate, a polyisocyanate, an oligoisocyanate, or a combination thereof.
19. The method of claim 2, wherein the isocyanate is hexamethylene diisocyanate, poly(hexamethylene diisocyanate), toluene diisocyanate, diphenylmethane diisocyanate, an aliphatic polyisocyanate, triphenylmethyl triisocyanate, or a mixture thereof.
20. The method of claim 6, wherein the sol-gel like material is dried supercritically.
21. The method of claim 20, wherein the sol-gel like material is dried with liquid carbon dioxide.
22. The method of claim 6, wherein the sol-gel like material is air dried.
23. A material produced according to the method of claim 1.

24. A material produced according to the method of claim 6.
25. A cross-linked aerogel.
26. The cross-linked aerogel of claim 25, wherein the cross-linking agent comprises at least about 2% by weight of the cross-linked aerogel.
27. The cross-linked aerogel of claim 25, wherein the cross-linking agent comprises at least about 5% by weight of the cross-linked aerogel.
28. The cross-linked aerogel of claim 25, wherein the cross-linking agent comprises at least about 10% by weight of the cross-linked aerogel.
29. The cross-linked aerogel of claim 25, wherein the cross-linking agent comprises at least about 30% by weight of the cross-linked aerogel.
30. The cross-linked aerogel of claim 25, wherein the cross-linking agent comprises at least about 50% by weight of the cross-linked aerogel.
31. The cross-linked aerogel of claim 25, wherein the cross-linking agent comprises at least about 80% by weight of the cross-linked aerogel.
32. The cross-linked aerogel of claim 25, wherein the cross-linking agent comprises at least about 100% by weight of the cross-linked aerogel.
33. The cross-linked aerogel of claim 25, wherein the cross-linking agent comprises at least about 500% of the weight of the cross-linked aerogel.
34. The cross-linked aerogel of claim 25, wherein the cross-linking agent comprises at least about 1000% of the weight of the cross-linked aerogel.

35. The cross-linked aerogel of claim 25, wherein the cross-linking agent comprises at least about 2000% of the weight of the cross-linked aerogel.
36. The cross-linked aerogel of claim 25, wherein the aerogel is a silica aerogel.
37. The cross-linked aerogel of claim 25, wherein the aerogel is cross-linked with an isocyanate.
38. The cross-linked aerogel of claim 25, wherein the aerogel is cross-linked with hexamethylene diisocyanate, poly(hexamethylene diisocyanate), toluene diisocyanate, diphenylmethane diisocyanate, an aliphatic polyisocyanate, triphenylmethyl triisocyanate, or a mixture thereof.
39. The cross-linked aerogel of claim 25, wherein the aerogel is less brittle than native silica.
40. The cross-linked aerogel of claim 25, wherein the aerogel does not collapse when in contact with a liquid that comprises water, an alcohol, an ether, a hydrocarbon, an ester, a ketone, a carboxylic acid, a phosphoric acid, or a liquefied gas.
41. The cross-linked aerogel of claim 40, wherein the liquefied gas is nitrogen, argon, helium, hydrogen, or oxygen.
42. The cross-linked aerogel of claim 40, wherein the hydrocarbon is kerosene, gasoline, jet fuel, or rocket fuel.
43. A method to link an attached group to an aerogel comprising
 - a) contacting a sol-gel like material with a cross-linking agent that includes the attached group to form a cross-linked sol-gel like material; and
 - b) drying the cross-linked sol-gel like material from the aerogel.

44. A capacitor comprising a cross-linked aerogel.
45. A dielectric comprising a cross-linked aerogel.
46. An electrical circuit comprising a cross-linked aerogel.
47. A thermal insulating material comprising a cross-linked aerogel.
48. A tile, door, panel, shingle, shutter, beam, cooler, article of clothing, shoe, or boot comprising the thermal insulating material according to claim 47.
49. A structural material comprising a cross-linked aerogel.
50. A method to dry a cross-linked aerogel comprising:
 - a) washing the cross-linked aerogel in a solvent to form a washed aerogel; and
 - b) drying the washed aerogel under non-supercritical conditions.
51. The method of claim 50, wherein the drying is conducted at ambient pressure.
52. The method of claim 50, wherein the drying is conducted at a temperature that is at least about 4°C.
53. The method of claim 50, wherein the drying is conducted at a temperature that is at least about 20°C.
54. The method of claim 50, wherein the drying is conducted at a temperature that is at least about 40°C.
55. The method of claim 50, wherein the drying is conducted at a temperature that is at least about 60°C.

56. The method of claim 50, wherein the drying is conducted at a temperature that is at least about 80°C.
57. The method of claim 50, wherein the drying is conducted at a temperature that is at least about 100°C.
58. The method of claim 50, wherein the drying is conducted at a temperature that is at least about 200°C.
59. The method of claim 50, wherein the drying is conducted at a temperature that is about or less than 300°C.
60. The method of claim 50, wherein the drying is conducted at a temperature of about 40°C.
61. The method of claim 50, wherein the drying is by freeze-drying.
62. The method of claim 50, wherein the solvent is an organic solvent.
63. The method of claim 50, wherein the organic solvent comprises a (C₁-C₂₀)alcohol, a (C₁-C₂₀)alkane, a (C₁-C₂₀)cycloalkane, a (C₁-C₂₀)alkene, a (C₁-C₂₀)cycloalkene, a (C₁-C₂₀)alkyne, an aryl, a (C₁-C₂₀) alkane substituted aryl, a (C₁-C₂₀)alkene substituted aryl, or a (C₁-C₂₀)alkyne substituted aryl.
64. The method of claim 62, wherein the organic solvent is a (C₅-C₁₀)alkane.